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MEMORANDUM

To: Susan Griffin, U.S. EPA Regional Toxicologist
cc: Scott Brown, U.S. EPA Remedial Project Manager
From: Bill Brattin
Date: 07/30/2007
Re: Preliminary Remediation Goals (PRGs) for Commercial and Recreational Land Use Scenarios at East Helena

Susan

As requested by Scott, I have calculated Preliminary Remedial Goals for lead and arsenic in soil at the East Helena site for commercial and recreational land uses. These calculations are described below.

PRGs for Lead

PRGs for lead were calculated using the Adult Lead Model recommended by USEPA (2003) (Recommendations of the Technical Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to lead in Soil. EPA-540-R-03-001). In brief, the basic equation is as follows:

$$\text{PbB(mother)} = \text{PbB}_0 + \text{BKSF}(\text{PbS}\cdot\text{IR}\cdot\text{AF}\cdot\text{EF}/365)$$
$$\text{PbB(fetus)} = 0.9 \cdot \text{PbB(mother)}$$
$$95^{\text{th}}\ \text{percentile(fetus)} = \text{PbB(fetus)}\cdot\text{GSD}^{1.645}$$

where:

PbB = Central estimate of blood lead concentrations (ug/dL).

PbB_0 = Typical blood lead concentration (ug/dL) in women of child-bearing age in the absence of exposures to the site that is being assessed.

BKSF = Biokinetic slope factor relating (quasi-steady state) increase in typical

adult blood lead concentration to average daily lead uptake (ug/dL blood lead increase per ug/day lead uptake)

PbS = Soil lead concentration (ug/g) (appropriate average concentration for individual)

IR = Intake rate of soil, including both outdoor soil and indoor soil-derived dust (g/day)

AF = Absolute gastrointestinal absorption fraction for ingested lead in soil and lead in dust derived from soil (dimensionless). The value of AFs is given by:

$$AFs = AF(food) \cdot RBA(soil)$$

EF = Exposure frequency for contact with assessed soils and/or dust derived in part from these soils (days per year)

GSD = Geometric standard deviation

Given these equations, the PRG for lead is defined as the concentration in soil that yields a 95th percentile blood lead value in the fetus of 10 ug/dL.

Table 1 shows the input values used to perform the calculation of the PRG for lead for commercial and recreational populations at the site, along with the basis of each input value. The resulting PRG values are:

Land Use	PRG for Lead (ppm)
Commercial	1482
Recreational	3245

PRGs for Arsenic

PRGs for arsenic were calculated based on lifetime excess cancer risk using the standard equations recommended by EPA:

$$\text{Excess Risk} = 1 - \exp(-DI \cdot SF)$$

where:

DI	=	Lifetime average daily intake of arsenic (mg/kg-day)
SF	=	Slope factor for ingestion of arsenic $(mg/kg\text{-}d)^{-1}$

For recreational and commercial land uses, the value of DI is given by:

$$DI = C \cdot (IR/BW) \cdot (EF \cdot ED/AT) \cdot RBA$$

where:

C	=	Concentration of arsenic in soil (mg/kg)
IR	=	Intake rate of soil (kg/day)
BW	=	Body weight (kg)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
AT	=	Averaging time = 70 years · 365 days/yr = 25,550 days
RBA	=	Relative bioavailability

Given these equations, the PRG for arsenic is calculated as the concentration that yields a specified excess cancer risk level. For the purposes of this calculation, the target excess cancer risk was set at 1.499E-04 in order to be consistent with the approach taken previously for residential exposure to soil. Table 2 shows the input values used to calculate the PRGs for arsenic, along with the basis for each value. These values are intended to represent an Reasonable Maximum Exposure (RME) scenario for each land use. The resulting PRG values are summarized below:

Land Use	PRG for Arsenic (ppm)
Commercial	572
Recreational	794

REFERENCES

IRIS. 2007. Integrated Risk Information System. On-line database maintained by USEPA available at: http://www.epa.gov/iriswebp/iris/index.html.

ISSI. 2001. Memorandum to Scott Brown dated Dec 3, 2001, prepared by T. Hammon and B. Brattin (ISSI Consulting Company).

USEPA. 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." U. S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. OSWER Directive 9285.6-03.

USEPA. 2003. Recommendations of the Technical Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to lead in Soil. EPA-540-R-03-001.

TABLE 1. PRG CALCULATIONS FOR LEAD

Basic Model

PbB = PbB0 + BKSF*Csoil*IR*(EF/365)*AFsoil
Fetal 95th = PbB*GSD^1.645 * ratio
AFsoil = AFfood * RBA

Input Variable	Units	Future Worker		Recreational Visitor	
		Value	Source	Value	Source
Target 95th (fetal)	ug/dL	10	a	10	a
Ratio	--	0.9	a	0.9	a
GSD	--	1.8	a	1.8	a
PbB0	ug/dL	1.7	a	1.7	a
BKSF	ug/dL per ug/d	0.4	a	0.4	a
IR	g/day	0.05	a	0.05	c
EF	days	219	a	100	c
AFfood		0.2	a	0.2	a
RBA	--	0.71	b	0.71	b
PRG	mg/kg	1482		3245	

Sources

(a) USEPA 2003. Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Assiciated with Adult Exposures to Lead in Soil. EPA-540-R-03-001.

(b) USEPA. 2005. Re-evaluation of the IEUBK-Based Clean-up Level for Lead in Soil in East Helena, Montana. Prepared by USEPA Region 8 with technical assistance from Syracuse Research Corporation. March 3, 2005.

(c) Professional judgment.

TABLE 2. PRGs FOR ARSENIC

Basic Model

Risk = (C)*(IR*1E-06/BW)*(EF/365)*(ED/70) *(oSF*RBA)
PRG = (TR) / [(IR*1E-06/BW)*(EF/365*ED/70) *(oSF*RBA)]

Input Variable	Units	Future Worker		Recreational Visitor	
		Value	Source	Value	Source
Target risk	--	1.499E-04	a	1.499E-04	a
AT	yrs	70	b	70	b
IR	mg/day	100	b	100	d
BW	kg	70	b	70	b
EF	days/yr	250	b	150	d
ED	yrs	25	b	30	b
oSF	(mg/kg-d)-1	1.5	c	1.5	c
RBA	--	0.5	a	0.5	a

Results

PRG	ppm	572		794

Sources

(a) Memorandum to Scott Brown dated Dec 3, 2001, prepared by T. Hammon and B. Brattin (ISSI Consulting Company)

(b) USEPA. 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." U. S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. OSWER

(c) IRIS (2007)

(d) Professional judgment.